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U.S. Naval Proving Ground, Dahlgren, Va. (NPG Report No. 986)

Eighth Partial Report on Case Gun Ignition - Second Partial Report on Primer Research and Development - Final Report on Gun Firing Tests of 20 NOL Modified Mk. 46 Primers - and Appendixes A thru C

Blank, C.B.; Feistman, M.L. 12 June'52 21pp. table, graphs

Primers, Ordnance
Propellants, Cool

Ordnance and Armament (22)
Ammunition (1)

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U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 986

CASE GUN IGNITION

8th Partial Report

PRIMER RESEARCH AND DEVELOPMENT

2nd Partial Report

GUN FIRING TESTS OF 20 NOL MODIFIED MK. 46 PRIMERS

FINAL Report

Copy No. 27

Task Assignment NPG-Re2a-184-1-52

Classification CONFIDENTIAL SECURITY INFORMATION

NPG REPORT NO. 986

Gun Firing Tests of 20 NOL Modified Mk. 46 Primers

PART A

SYNOPSIS

1. This report presents the results of 3"/70 large chamber (Type G) gun firing tests of 20 Mk. 46 primers modified by the Naval Ordnance Laboratory as follows:

a. 5 primers contained 31 grams of an Fe-$KClO_4$ mix in a 1 to 1 ratio packed at the base end of the primer extension tube and occupying the same volume as the standard charge of 26 grams of black cannon powder.

b. 5 primers contained 31 grams of an Fe-$KClO_4$ mix in a 1 to 1 ratio packed at the forward end of the extension tube above a plastic spacer.

c. 5 primers contained 80 grams of an Fe-$KClO_4$ mix in a 1 to 1 ratio packed the full length of the extension tube.

d. 5 primers contained 26 grams of black cannon powder in the forward end of the extension tube above a plastic spacer.

2. The pressure-time curves obtained with the above primers and Mk. 46 primers fired for control purposes indicated the following:

a. Primers containing the Fe-$KClO_4$ mix packed at the base of the extension tube produced slightly smoother curves than those containing black cannon powder packed in the same position.

b. Primers containing the Fe-$KClO_4$ mix packed at the front of the extension tube produced much worse curves than those containing the black cannon powder packed in the same position.

c. Primers containing the Fe-$KClO_4$ mix exhibited much smoother curves when the charge was packed at the base rather than at the front of the tube.

d. Primers containing black cannon powder exhibited slightly worse curves when the charge was packed at the base rather than at the front of the tube.

e. Primers having the extension tube completely filled with the Fe-$KClO_4$ mix gave curves that fell between those obtained with this mix at the base and at the front of the tube. Ejection times for the full tubes were the shortest obtained.

3. Primers containing black cannon powder gave the longest ejection times.

4. Ballistic uniformity for each group was satisfactory.

Gun Firing Tests of 20 NOL Modified Mk. 46 Primers

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Gun Firing Tests of 20 NOL Modified Mk. 46 Primers

PART B

INTRODUCTION

1. AUTHORITY:

Task Assignment NPG-Re2a-184-1-52 (Conf.)

2. REFERENCES:

a. BUORD Conf ltr Re2a-HWK:rds NP9 to NAVPROV of 4 August 1951
b. Task Assignment NPG-Re2a-184-1-52 (Conf)
c. NOL Conf ltr WC:LL:lk NP/NOL/XI-1(1093) Ser 01560-12682 to NAVPROV of 5 September 1951

3. BACKGROUND:

Reference (a) requested that the Naval Proving Ground undertake the task assignment, under which this report was written. In reference (a), the Naval Proving Ground was requested to cooperate with the Naval Ordnance Laboratory and other activities engaged in evaluating experimental primers or primer component designs. Reference (c) requested the tests upon which this report is based.

4. OBJECT OF TEST:

To evaluate the performance of the subject primers with cool propellants in the 3"/70 caliber large chamber gun.

5. PERIOD OF TEST:

a.	Date of Project Letter	5 September 1951
b.	Date Material Received	18 September 1951
c.	Date Commenced Test	26 September 1951
d.	Test Completed	26 September 1951

PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEMS UNDER TEST:

Four modifications of Mk. 46 (XCM-11) primers were fired. The modifications and modification designations are as follows:

a. 31 grams of an Fe-$KClO_4$ mix in a 1 to 1 ratio, packed at the base end of the extension tube and occupying the same volume as the standard charge of 26 grams of black cannon powder.

b. 31 grams of an Fe-$KClO_4$ mix in a 1 to 1 ratio, packed at the forward end of the extension tube above a plastic spacer.

c. 80 grams of an Fe-$KClO_4$ mix in a 1 to 1 ratio, packed the full length of the extension tube.

d. 26 grams of black cannon powder packed in the forward end of the extension tube above a plastic spacer.

The iron in the primer mix was prepared from iron carbonyl and was very pure. It was believed to be more stable (with respect to its oxidational properties) than other varieties of iron powder available.

7. PROCEDURE:

The subject primers were fired in the 3"/70 caliber large chamber gun with cool picrite propellant (1% lead carbonate) HKPC-1. Velocities, maximum pressures (copper crusher), ejection times, and pressure-time records were obtained as follows:

Velocities were obtained by measuring the time of passage of the magnetized projectile through a set of coils. The values reported are estimated to be accurate within ± 5 ft/sec.

Maximum pressures were recorded by copper crusher type gages and are considered accurate to ± 0.9 t.s.i.

Ejection times were measured from time of closing of the firing circuit to the passage of the magnetized projectile through muzzle coil. This measurement is considered accurate to ± 0.4 milliseconds.

Pressure-time records were taken with expanding ferrule resistance wire strain type gages and associated recording equipment as set up and operated by the Armament Laboratories Division. These gages are estimated to be accurate to ± 2%.

8. RESULTS AND DISCUSSION:

a. The firing data obtained is tabulated in Appendix (A). HKPC-1 was selected as the test propellant because of the smooth pressure-time curves and ballistic level attainable.

b. In both primer types in which the charge was at the base of the extension tube, the primers containing the Fe-$KClO_4$ mix (modification (a)), Figure 2, Appendix (B), produced slightly smoother curves over those containing the black cannon powder (Mk. 46 primer), Figure 1, Appendix (B). The ejection times were longer by about 2 milliseconds for the rounds with the Mk. 46 primers.

c. In both primer types in which the charge was at the front of the extension tube, the primers containing the black cannon powder (modification (d)), Figure 5, Appendix (B), gave much smoother curves than those containing the Fe-$KClO_4$ mix (modification (b)), Figure 3, Appendix (B). As in (a) above, ejection times were longer for the black cannon powder primers by about 6 milliseconds.

d. The curves for the primers containing the same charge of Fe-$KClO_4$, but at different positions in the primer, indicted that primer modification (a), Figure 2, Appendix (B), in which the charge was at the base produced much smoother curves than primer modification (b), Figure 3, Appendix (B), in which the charge was at the front. Ejection times were about the same for each.

e. The curves for the primers containing the same charge, black cannon powder, but again at different positions in the primer, indicated that placing the charge at the front of the extension tube, modification (d), Figure 5, Appendix (B), gave slightly smoother curves than with the Mk. 46 primer, Figure 1, Appendix (B), in which the charge was at the base. Ejection times were longer by about 2 milliseconds for the modification (d) primers.

f. Completely filling the extension tube with the Fe-$KClO_4$ mix (modification (c)) Figure 4, Appendix (B), produced curves that fell between those obtained with modifications (a) and (b) primers. Ejection times for these rounds were the shortest obtained.

g. Ballistic uniformity for each group was satisfactory.

h. The results as discussed above indicate that the position in the extension tube of the primer charge for optimum propellant ignition may be dependent upon the composition of the primer charge. This phenomena will be investigated as ignition studies are continued.

PART D

CONCLUSIONS

9. a. Primers containing the Fe-$KClO_4$ mix packed at the base of the extension tube produced slightly smoother pressure-time curves than those containing black cannon powder packed in the same position.

b. Primers containing the Fe-$KClO_4$ mix packed at the front of the extension tube produced much worse curves than those containing the black cannon powder packed in the same position.

c. Primers containing the Fe-$KClO_4$ mix exhibited much smoother curves when the charge was packed at the base rather than at the front of the tube.

d. Primers containing black cannon powder exhibited slightly worse curves when the charge was packed at the base rather than at the front of the tube.

e. Primers having the extension tube completely filled with the Fe-$KClO_4$ mix gave curves falling between those obtained with the mix at the base and at the front of the tube. Ejection times were shortest for these rounds.

f. Primers containing the black cannon powder gave the longest ejection times.

PART E

RECOMMENDATIONS

10. In view of existing evidence that optimum propellant ignition is dependent upon both primer charge composition and location in the extension tube, it is requested that the Naval Ordnance Laboratory supply the Naval Proving Ground with various type mixes so that a study of the optimum position for each type primer charge may be conducted.

PART F

DISPOSITION OF MATERIAL

11. All primers were returned to Naval Ordnance Laboratory after firing tests were completed.

Gun Firing Tests of 20 NOL Modified Mk. 46 Primers

The tests upon which this report is based were conducted by:
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NPG REPORT NO. 986

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Eighth Partial Report

on

Case Gun Ignition

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Gun Firing Tests of

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Project No.: NPG-Re2a-184-1-52
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Gun Firing Tests of 20 NOL Modified Mk. 46 Primers

TABLE I

FIRING DATA

Gun:	3"/70 Caliber, Type G-2, No. 24491
Projectile:	15.00 lbs. Epsom Salt Loaded Ex-24-5
Lead Foil:	None
Wad:	Cardboard, NGF Dwg. No. 132664 Pc. No. 13
Spacer:	None
Powder:	HKPC-1
Powder Temp.:	90°

Date: 26 September 1951

Rd. No.	Primer	PPD (in.)	Charge (lbs.)	Velocity (f/s)	Pressure (t.s.i.)	Ej. Time (Millisec.)
1	Mk-46	1.7	10.01	3412	20.0	14
2	Mk-46 Mod. d	"	"	3391	20.4	22
3	"	"	"	3402	20.5	22
4	"	"	"	3409	20.6	18
5	"	"	"	3409	20.9	18
6	"	"	"	3419	20.8	18
7	Mk-46 Mod. a	2.5	9.80	3364	20.2	14
8	"	1.7	10.01	3382	20.7	14
9	"	"	"	3378	19.8	14
10	"	"	"	3408	20.9	15
11	"	"	"	3407	20.2	14
12	Mk-46 Mod. b	"	"	3406	21.1	14
13	"	"	"	3415	21.4	11

Gun Firing Tests of 20 NOL Modified Mk. 46 Primers

TABLE I (Continued)

Date: 26 September 1951 (Continued)

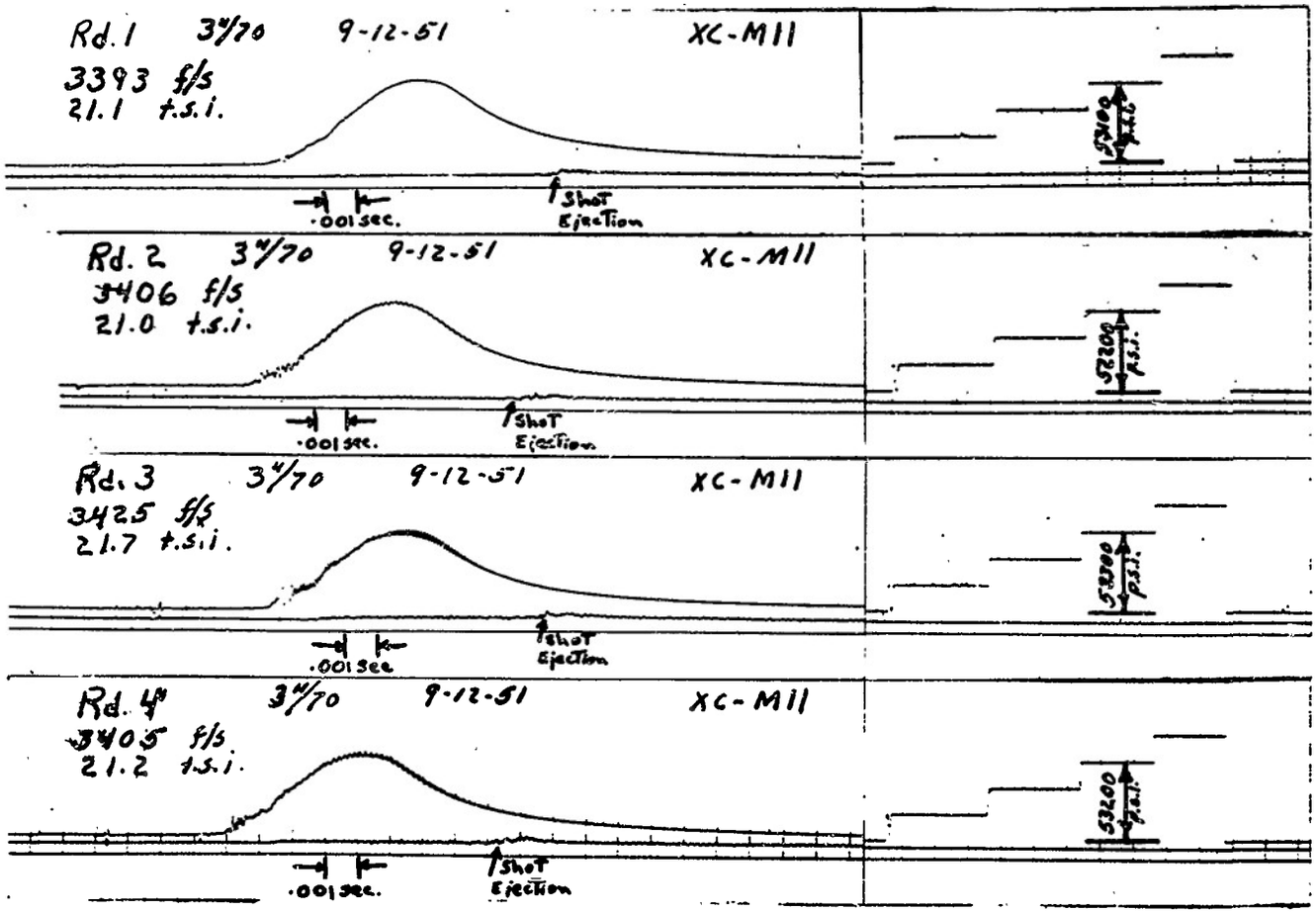
Rd. No.	Primer	PPD (in.)	Charge (lbs.)	Velocity (f/s)	Pressure (t.s.i.)	Ej. Time (Millisec.)
14	Mk-46 Mod. b	1.7	10.01	3419	20.6	14
15	"	"	"	3409	21.1	12
16	"	"	"	3451	21.4	15
17	Mk-46 Mod. c	5.1	9.00	3167	16.5	--
18	"	1.7	10.01	3404	20.4	13
19	"	"	"	3429	21.0	12
20	"	"	"	3407	21.3	13
21	"	"	"	3397	20.8	13

Date: 12 September 1951

Rd. No.	Primer	PPD (in.)	Charge (lbs.)	Velocity (f/s)	Pressure (t.s.i.)	Ej. Time (Millisec.)
1	Mk-46	1.7	10.01	3393	21.1	19
2	"	"	"	3406	21.0	15
3	"	"	"	3425	21.7	18
4	"	"	"	3405	21.2	15

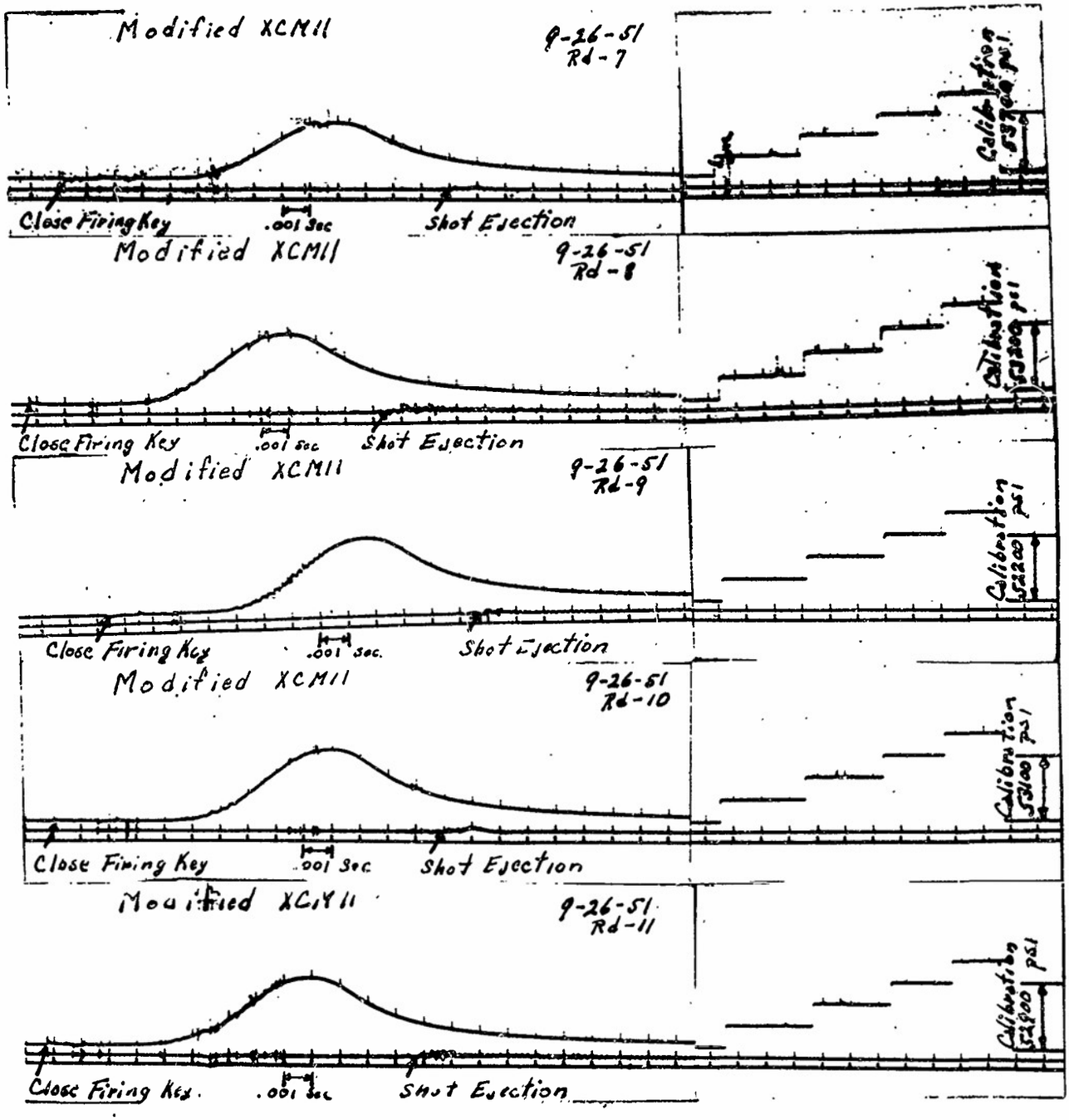
Gun Firing Tests of 20 NOL Modified Mk. 46 Primers

Mk. 46 Primer



Gun Firing Tests of 20 NOL Modified Mk. 46 Primers

Mk. 46 Primer - Modification A



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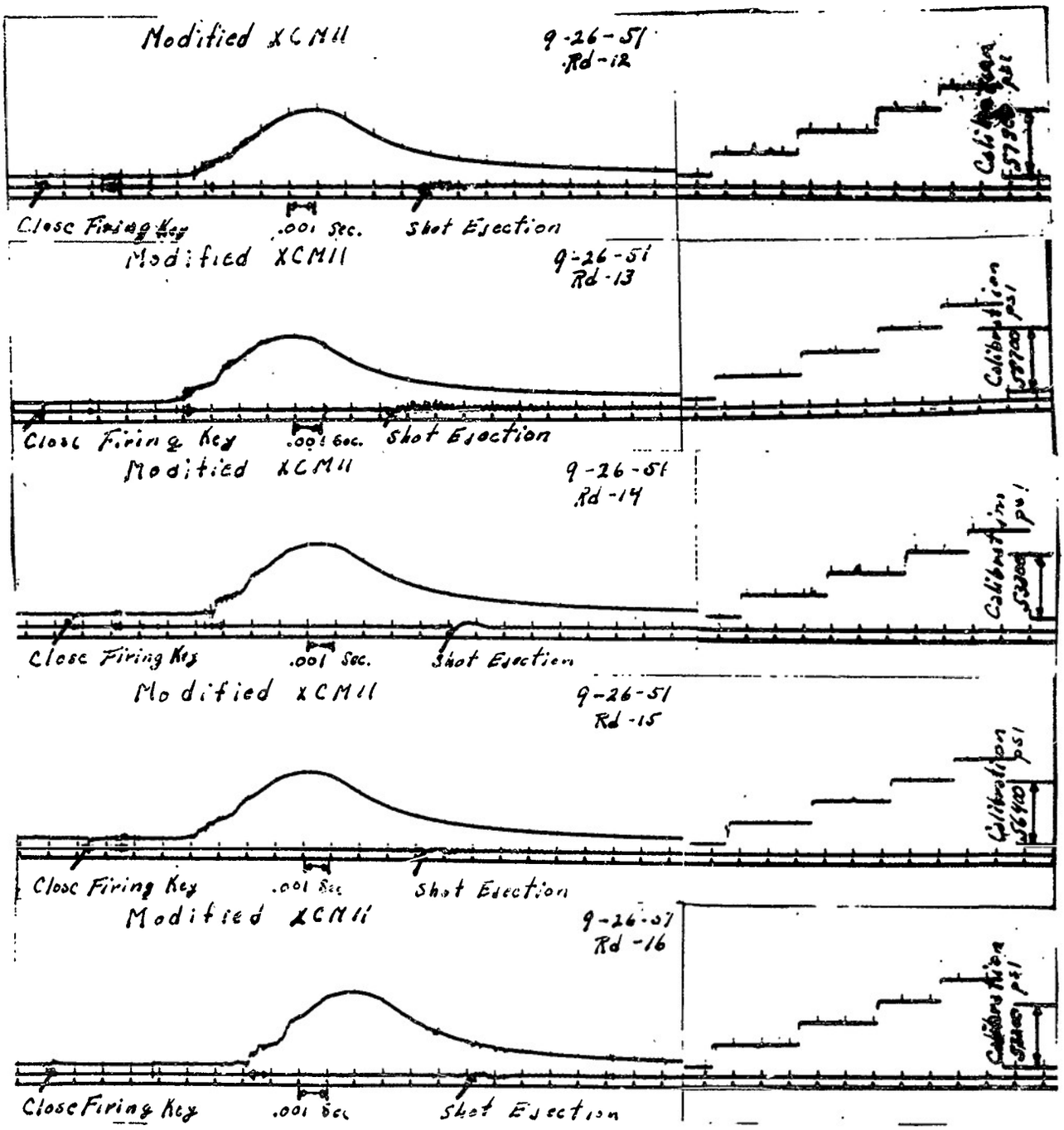
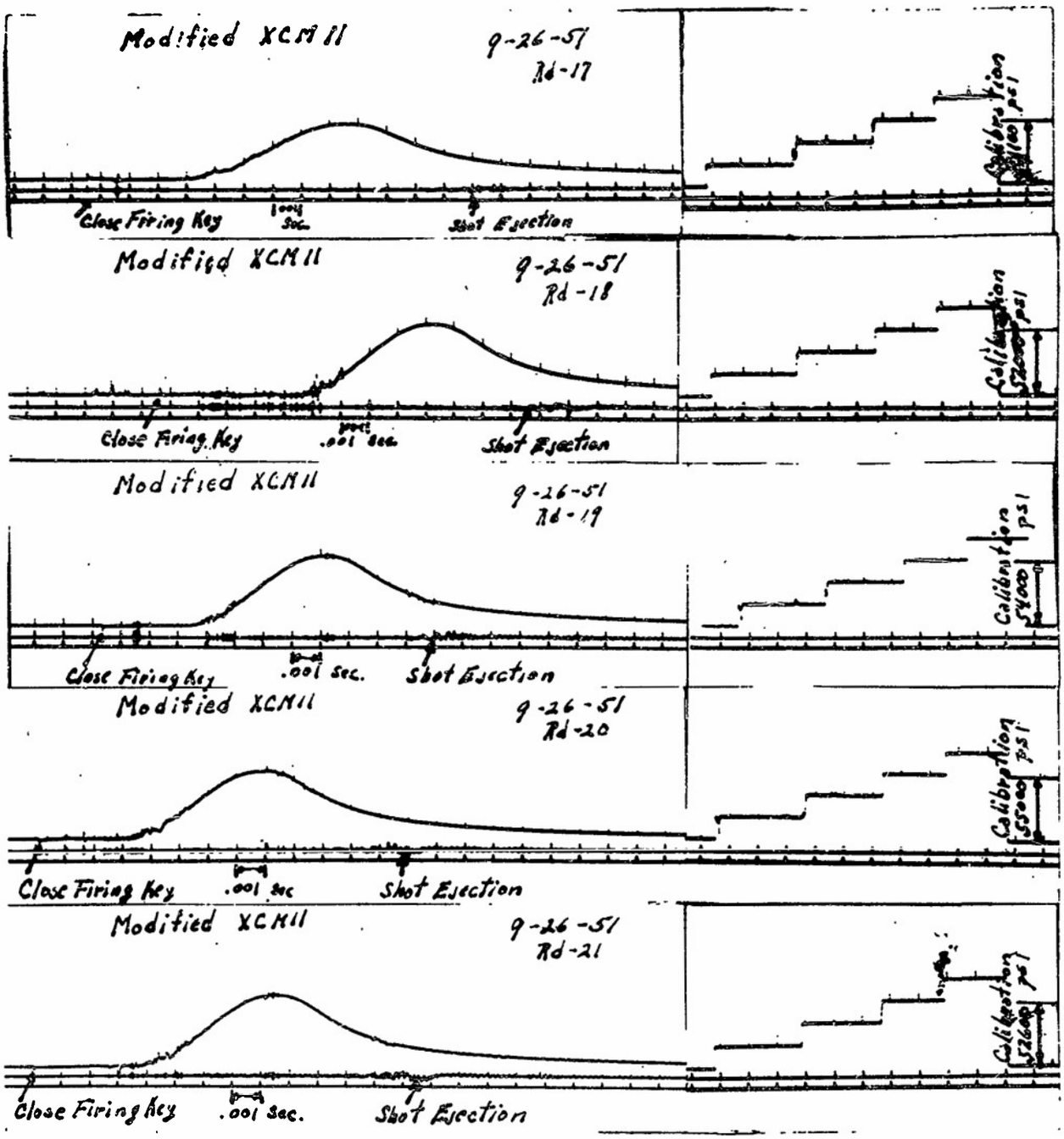
Mk. 46 Primer - Modification B



Gun Firing Tests of 20 NOL Modified Mk. 46 Primers

Mk. 46 Primer - Modification C



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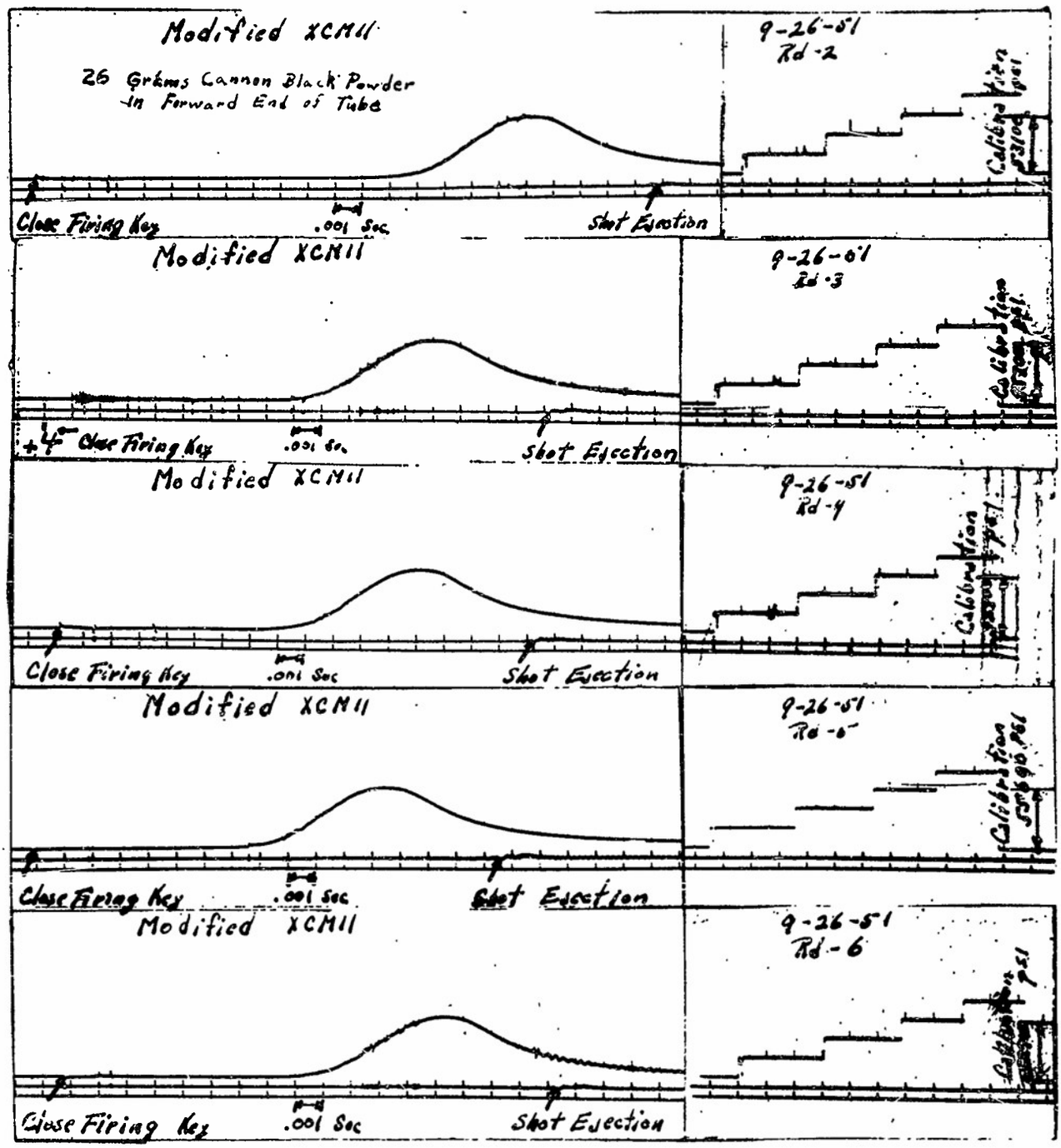
Mk. 46 Primer - Modification D



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